PATENT ABSTRACTS OF JAPAN

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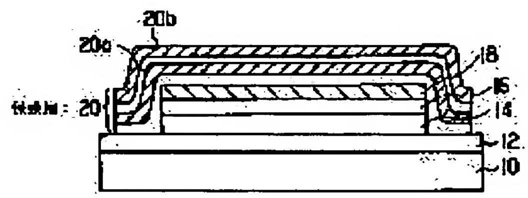
(54) ORGANIC EL ELEMENT

(57)Abstract:
PROBLEM TO BE SOLVED: To prevent the diffusion of moisture into an element and improve heat radiation.
SOLUTION: A transparent electrode 12, a positive hole transport layer 14, a luminescence layer 16 and a metal cathode 18 are formed on a glass substrate 10. The positive hole transport layer 14, the luminescence layer 16 and the metal cathode 18 are covered to form a protecting layer 20. The protecting layer 20 is formed in a multilayer structure with an insulating layer 20a and a metal layer 20b. In special, the metal layer 20 is provided in the protecting layer, so that the entry of moisture into an element is prevented and heat radiation is improved.



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CLAIMS

[Claim(s)]
[Claim 1] The organic EL device characterized by having the protective layer which consists one [at least] electrode and the outside of a luminous layer of multilayer structure which contains two-layer [of an organic layer and a metal layer], or two-layer [of an inorganic layer and a metal layer] as wrap ******** in the organic EL device which makes a luminous layer emit light by ****(ing) the luminous layer which becomes inter-electrode [of a pair] from an organic material, and pouring a carrier into a luminous layer from two electrodes.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention **** the luminous layer which becomes inter-electrode [of a pair] from an organic material, and relates to the structure of the organic EL device which makes a luminous layer emit light, especially its protective layer by pouring a carrier into a luminous layer from two electrodes.
[0002]
[Description of the Prior Art] The flat-surface display using an organic EL device is capturing the big spotlight as a next-generation display, and the researches and developments about this are done briskly. If an organic EL device is used especially, the high quality display which has the descriptions, such as a direct-current low-battery drive, a high angle of visibility, and spontaneous light, can be realized, and it is thought that the utility value is very high.
[0003] This organic EL device has the configuration which carried out laminating formation of a transparent electrode (anode plate) / electron hole transportation layer / luminous layer / the metal electrode (cathode) for example, on the glass substrate. Moreover, the big matter of a work function is used for an anode plate, and the small matter of a work function is used for cathode. And an organic material is used for an electron hole transportation layer and a luminous layer, and light is emitted when an electron recombines with the electron hole poured in from two electrodes in a luminous layer.
[0004] Here, the solid-state organic material used for an electron hole transportation layer or a luminous layer tends to be invaded by moisture, oxygen, etc., and if an organic EL device is driven in atmospheric air, the luminescence property will deteriorate rapidly. Furthermore, it is necessary to make it the electrode prepared on a solid-state organic material not oxidize. Therefore, it is necessary to prepare organic and an inorganic protective layer, to close a component, and to isolate from atmospheric air in an organic EL device. For example, JP,7-192867,A has the indication about various kinds of closure approaches.
[0005]
[Problem(s) to be Solved by the Invention] Thus, although the life of an organic EL device could be prolonged by preparing a protective layer, when sufficient antioxidizing and invasion prevention of moisture were aimed at, there was a problem that heat dissipation nature will worsen. That is, when thickness of a protective layer was made not much thick, the heat generated in the component stops having radiated heat enough, and there was a problem that the property of a component will deteriorate.
[0006] Especially the brightness that is required of an EL element in the usual case is about two 200 cd/m, the drive currents for it are several two or less mA/cm, and the effect of generation of heat is not so large. However, with an organic EL device, the brightness which exceeds 1000 cd/m2 by impression of 10V is obtained, and there is also a report that brightness improves further and the brightness of 100,000 cd/m2 is obtained by doping to a luminous layer by the latest research. For example, considering using an organic EL device as the flat-surface light source, several 1000 cd/m2 needs to emit light, and a current required for it becomes two or more 100 mA/cm. In this case, a chip temperature will exceed 100-degreeC, the fall of brightness and the point emitting [un-] light will occur, and degradation of a component will take place. Therefore, in such an organic EL device of high brightness,

[0015] In such an organic EL device, by impressing an electrical potential difference to a transparent electrode 12 and the metal cathode 18, an electron hole and an electron are poured in, and this recombines and emits light in a luminous layer 16 from two electrodes 12 and 18. With this operation gestalt, since the component section which consists of the electron hole transportation layer 14, a luminous layer 16, and metal cathode 18 is covered with the protective layer 20, diffusion inside the oxygen from atmospheric air and moisture is effectively prevented by it, and can eliminate the bad influence to a component property by it.

[0016] Especially, in the component of this operation gestalt, the protective layer 20 contains metal layer 20b. Metal layer 20b has very precise structure, and prevents diffusion of oxygen or moisture effectively. It can prevent effectively also about diffusion of oxygen by using what forms the oxide film of passive states, such as aluminum, as metal layer 20b especially.
[0017] Moreover, since the metal layer 20 has good thermal conductivity, it can radiate effectively the heat generated in the component section, and can prevent heating of the component section. When the amount of currents is enlarged with 100 mA/cm2 - about two 1 A/cm and the amount of luminescence is especially enlarged with 1000 - 10000 cd/m2, the calorific value of the component section is large and the heat dissipation becomes an important technical problem. According to the component of this operation gestalt, also in the component of such an amount of large luminescence, degradation of a property is made to the minimum.
[0018] Moreover, with this operation gestalt, since insulating-layer 20a has been arranged on the metal cathode 18, metal layer 20b and the metal cathode 18 can be electrically insulated by this. Furthermore, since metal layer 20b has been arranged on the maximum outside, the heat dissipation effectiveness is made to a sufficiently big thing.
[0019] About 200nm, insulating-layer 20a of a protective layer 20, and metal layer 20b have [the electron hole transportation layer 14 and a luminous layer 16 / about 50nm and the metal cathode 18] the thickness of about 200nm desirable [in addition,]. Heat dissipation is possible for a very effective thing by making metal cathode 18 comparatively thick of 200nm or more especially.
[0020] Moreover, although laminating formation of the electron hole transportation layer 14 and the luminous layer 16 was carried out with the above-mentioned operation gestalt, it is good also as 1 lamination of a mixed organic layer. Furthermore, it is good also as a configuration which prepares not the electron hole transportation layer 14 but an electronic transportation layer in the metal cathode 18 side. Furthermore, it is also possible to use a transparent electrode 12 as cathode and to make a counterelectrode into an anode plate. Thus, various kinds of configurations known now are employable as the configuration of the component section.
[0021]
[Example]
On the ″example 1″ glass substrate 10 currently formed beforehand, with vacuum deposition, 50nm of triphenyl diamines was deposited, and the transparent electrode 12 of ITO formed the electron hole transportation layer 14, deposited 50nm of quinolinol aluminum complexes after that, and formed the luminous layer 16. And on this luminous layer 16, 200nm vacuum evaporationo formation of the MgAg was carried out, the metal cathode 18 was formed, and the component was formed. Then, on this component section, the laminating of MgF2 and the aluminum was carried out by turns, and the protective layer 20 which consists of insulating-layer 20a and metal layer 20b was formed. In this example, both thickness of insulating-layer 20a and metal layer 20b was set to 200nm, and formed three layers of these at a time.
[0022] The continuation drive of this component was carried out by drive current 10 mA/cm2, and the reduction-by-half life of brightness was measured. The life of about 3000 hours has been attained by initial brightness 200 cd/m2 (refer to drawing 2).
[0023] On the other hand, when the same drive was carried out in the formed component (with no protective layer 20) to the metal cathode 18, the reduction-by-half life was about 500 hours. This result is shown in drawing 2 . Moreover, when the continuation drive of the

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TECHNICAL FIELD

[Field of the Invention] This invention **** the luminous layer which becomes inter-electrode [of a pair] from an organic material, and relates to the structure of the organic EL device which makes a luminous layer emit light, especially its protective layer by pouring a carrier into a luminous layer from two electrodes.

[Translation done.]

PRIOR ART

[Description of the Prior Art] The flat-surface display using an organic EL device is capturing the big spotlight as a next-generation display, and the researches and developments about this are done briskly. If an organic EL device is used especially, the high quality display which has the descriptions, such as a direct-current low-battery drive, a high angle of visibility, and spontaneous light, can be realized, and it is thought that the utility value is very high.
[0003] This organic EL device has the configuration which carried out laminating formation of a transparent electrode (anode plate) / electron hole transportation layer / luminous layer / the metal electrode (cathode) for example, on the glass substrate. Moreover, the big matter of a work function is used for an anode plate, and the small matter of a work function is used for cathode. And an organic material is used for an electron hole transportation layer and a luminous layer, and light is emitted when an electron recombines with the electron hole poured in from two electrodes in a luminous layer.
[0004] Here, the solid-state organic material used for an electron hole transportation layer or a luminous layer tends to be invaded by moisture, oxygen, etc., and if an organic EL device is driven in atmospheric air, the luminescence property will deteriorate rapidly. Furthermore, it is necessary to make it the electrode prepared on a solid-state organic material not oxidize. Therefore, it is necessary to prepare organic and an inorganic protective layer, to close a component, and to isolate from atmospheric air in an organic EL device. For example, JP,7-192867,A has the indication about various kinds of closure approaches.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Thus, although the life of an organic EL device could be prolonged by preparing a protective layer, when sufficient antioxidizing and invasion prevention of moisture were aimed at, there was a problem that heat dissipation nature will worsen. That is, when thickness of a protective layer was made not much thick, the heat generated in the component stops having radiated heat enough, and there was a problem that the property of a component will deteriorate.

[0006] Especially the brightness that is required of an EL element in the usual case is about two 200 cd/m, the drive currents for it are several two or less mA/cm, and the effect of generation of heat is not so large. However, with an organic EL device, the brightness which exceeds 1000 cd/m2 by impression of 10V is obtained, and there is also a report that brightness improves further and the brightness of 100,000 cd/m2 is obtained by doping to a luminous layer by the latest research. For example, considering using an organic EL device as the flat-surface light source, several 1000 cd/m2 needs to emit light, and a current required for it becomes two or more 100 mA/cm. In this case, a chip temperature will exceed 100-degreeC, the fall of brightness and the point emitting [un-] light will occur, and degradation of a component will take place. Therefore, in such an organic EL device of high brightness, calorific value is large and this cure is important. In addition, acceleration according [degradation of the component by heat] to the heat of a structural change of organic layers, such as a luminous layer, or electrode oxidation is the cause.

[0007] This invention aims at offering an organic EL device with a sufficient heat dissipation property while it is made for solving the above-mentioned technical problem and it can perform sufficient closure.

[Translation done.]

MEANS

[Means for Solving the Problem] By ****(ing) the luminous layer which becomes inter-electrode [of a pair] from an organic material, and pouring a carrier into a luminous layer from two electrodes, in the organic EL device which makes a luminous layer emit light, this invention is a wrap protective layer about one [at least] electrode and the outside of a luminous layer, and is characterized by having the protective layer which consists of multilayer structure containing two-layer [of an organic layer and a metal layer], or two-layer [of an inorganic layer and a metal layer].
[0009] Thus, by this invention, the electrode and the luminous layer were covered by the protective layer. By this, diffusion of the moisture to one electrode (for example, metal cathode) and the perimeter ambient atmosphere of a luminous layer or oxygen can be prevented, property degradation of a component can be controlled, and reinforcement can be attained. Especially, the protective layer contains the metal layer. The metal layer has very precise structure and prevents diffusion of oxygen or moisture effectively. Furthermore, it can prevent effectively also about diffusion of oxygen by using what forms the oxide film of passive states, such as aluminum, as a metal layer.
[0010] Moreover, since the metal layer has good thermal conductivity, it can radiate effectively the heat generated in the component, and can prevent heating of a component. When the amount of currents is enlarged and the amount of luminescence is enlarged especially, the calorific value of a component is large and excelling in the heat dissipation nature becomes important requirements. According to this invention, also in the component of such an amount of large luminescence, degradation of a property is made to the minimum.
[0011] Moreover, if an insulating layer is arranged on an electrode, a metal layer and cathode can be insulated electrically. Furthermore, the heat dissipation effectiveness can be made sufficiently big by arranging a metal layer on the maximum outside.
[0012]
[Embodiment of the Invention] Hereafter, the gestalt (henceforth an operation gestalt) of operation of this invention is explained based on a drawing.
[0013] Drawing 1 is drawing showing the configuration of the organic EL device concerning this operation gestalt. The transparent electrode 12 is formed in the top face of a glass substrate 10. As for this transparent electrode 12, ITO (indium tin oxide), SnO_2, etc. are used. Laminating formation of the electron hole transportation layer 14 which consists of an organic material on this transparent electrode 12, and the luminous layer 16 is carried out. The electron hole transportation layer 14 is formed of TPD (triphenyl diamine), and a luminous layer 16 is formed of Alq (quinolinol aluminum complex) etc. The metal cathode 18 is formed on a luminous layer 16. MgAg (9:1), AlLi (9.9:0.1), MaIn (9:1), etc. are adopted as this metal cathode 18.
[0014] And a protective layer 20 is formed so that the whole including the side face of this electron hole transportation layer 14, a luminous layer 16, and the metal cathode 18 may be covered. This protective layer 20 is a multilayer layer of insulating-layer 20a and metal layer 20b, and the laminating of these is carried out alternately with two-layer [every]. Here, in addition to this, the same organic substance as what was used for the electron hole transportation layer 14 or the luminous layer 16, and various kinds of organic substance of low-molecular and a macromolecule can be used for insulating-layer 20a. Furthermore, it is

EXAMPLE

[Example]
On the "example 1" glass substrate 10 currently formed beforehand, with vacuum deposition, 50nm of triphenyl diamines was deposited, and the transparent electrode 12 of ITO formed the electron hole transportation layer 14, deposited 50nm of quinolinol aluminum complexes after that, and formed the luminous layer 16. And on this luminous layer 16, 200nm vacuum evaporationo formation of the MgAg was carried out, the metal cathode 18 was formed, and the component was formed. Then, on this component section, the laminating of MgF_2 and the aluminum was carried out by turns, and the protective layer 20 which consists of insulating-layer 20a and metal layer 20b was formed. In this example, both thickness of insulating-layer 20a and metal layer 20b was set to 200nm, and formed three layers of these at a time.
[0022] The continuation drive of this component was carried out by drive current 10 mA/cm2, and the reduction-by-half life of brightness was measured. The life of about 3000 hours has been attained by initial brightness 200 cd/m2 (refer to drawing 2).
[0023] On the other hand, when the same drive was carried out in the formed component (with no protective layer 20) to the metal cathode 18, the reduction-by-half life was about 500 hours. This result is shown in drawing 2 . Moreover, when the continuation drive of the drive current was carried out by 500 mA/cm2, as shown in drawing 3 , luminescence stable 30 minutes or more has been attained. On the other hand, at the thing without a protective layer 20, a chip temperature rises rapidly and brightness has become 0 in about 10 minutes.
[0024] The triphenyl diamine which is the organic substance which constitutes the electron hole transportation layer 14 from the same configuration as the "example 2" example 1 as insulating-layer 20a was adopted. In addition, as metal layer 20b, aluminum is used like the above. The continuation drive of this component was carried out by drive current 10 mA/cm2, and the reduction-by-half life of brightness was measured. The life of about 2500 hours has been attained by initial brightness 200 cd/m2.

[Translation done.]

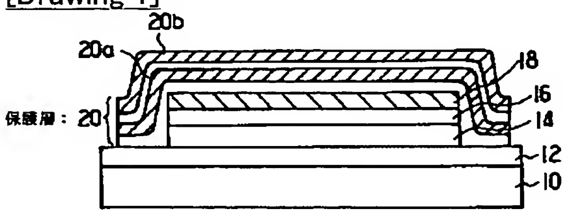
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the configuration of the operation gestalt of an organic EL device.
[Drawing 2] It is the property Fig. showing the life of this example.
[Drawing 3] It is the property Fig. showing the life of this example.
[Description of Notations]
10 A glass substrate, 12 A transparent electrode, 14 An electron hole transportation layer, 16 A luminous layer, 18 metal cathode, 20 A protective layer, 20a An insulating layer, 20b Metal layer.

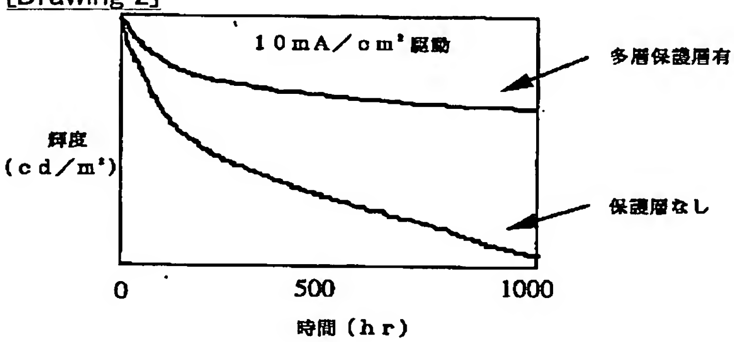
[Translation done.]

DRAWINGS

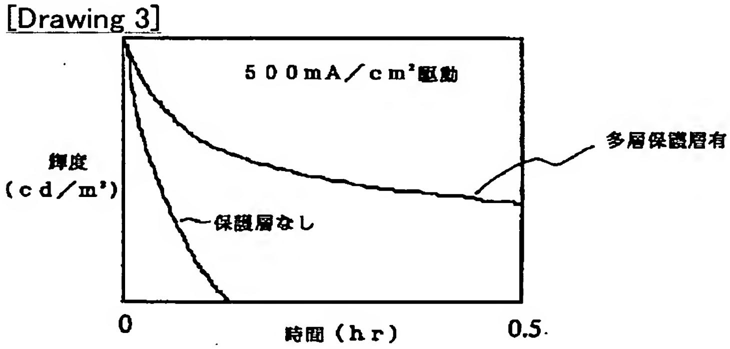
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]

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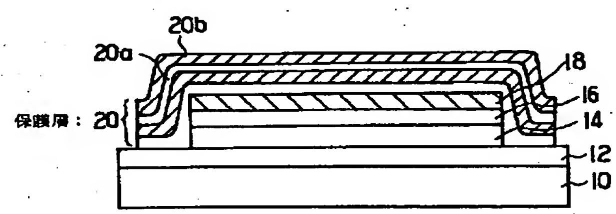
(54)【発明の名称】　有機ＥＬ素子

(57)【要約】
【課題】　素子への酸素水分の拡散を防止すると共に、放熱性を高める。
【解決手段】　ガラス基板１０上に透明電極１２、正孔輸送層１４、発光層１６、金属陰極１８を形成し、正孔輸送層１４、発光層１６、金属陰極１８を覆って保護層２０を形成する。保護層２０は、絶縁層２０ａと金属層２０ｂの多層構造となっている。特に、金属層２０を保護層中に有しているため、湿気の素子への進入を防止し、かつ放熱をよくすることができる。



【特許請求の範囲】

【請求項１】　一対の電極間に有機材料からなる発光層を狭持し、両電極からキャリアを発光層に注入することによって発光層を発光させる有機ＥＬ素子において、少なくとも一方の電極及び発光層の外側を覆う保護層あって、有機層と金属層の２層または無機層と金属層の２層を含む多層構造からなる保護層を有することを特徴とする有機ＥＬ素子。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、一対の電極間に有機材料からなる発光層を狭持し、両電極からキャリアを発光層に注入することによって発光層を発光させる有機ＥＬ素子、特にその保護層の構造に関する。

【０００２】

【従来の技術】有機ＥＬ素子を利用した平面ディスプレイは、次世代のディスプレイとして大きな注目を浴びており、これについての研究開発が盛んに行われている。特に、有機ＥＬ素子を利用すれば、直流低電圧駆動、高視野角、自発光などの特徴を有する高解像度ディスプレイが実現可能であり、その利用価値は非常に高いと考えられている。

【０００３】この有機ＥＬ素子は、例えばガラス基板上に、透明電極（陽極）／正孔輸送層／発光層／金属電極（陰極）を積層形成した構成を有している。また、陽極には仕事関数の大きな物質が用いられ、陰極には仕事関数の小さな物質が用いられる。そして、正孔輸送層及び発光層に有機材料が用いられ、両電極から注入される正孔と、電子が発光層において、再結合することによって発光する。

【０００４】ここで、正孔輸送層や発光層に利用する固体有機材料は、水分や、酸素などに侵されやすく、大気中で有機ＥＬ素子を駆動するとその発光特性が急激に劣化する。さらに、固体有機材料上に設けられる電極が酸化されないようにする必要もある。従って、有機ＥＬ素子では、有機や無機の保護層を設け、素子を封止して大気から隔離する必要がある。例えば、特開平７－１９２８６７号公報には、各種の封止方法についての開示がある。

【０００５】

【発明が解決しようとする課題】このように、保護層を設けることによって、有機ＥＬ素子の寿命を延ばすことができるが、十分な酸化防止や水分の侵入防止を図ると、放熱性が悪くなってしまうという問題があった。すなわち、保護層の厚みをあまり厚くすると、素子において発生した熱が十分放熱されなくなり、素子の特性が劣化してしまうという問題があった。

【０００６】特に、通常の場合、ＥＬ素子に要求される輝度は２００ｃｄ／m^2程度であり、このための駆動電流は数ｍＡ／ｃm^2以下であり、発熱の影響はあまり大きくない。しかし、有機ＥＬ素子では、１０Ｖの印加で１０００ｃｄ／m^2を超える輝度が得られ、最近の研究では、発光層へのドーピングによって、輝度はさらに改善され、１０万ｃｄ／m^2の輝度が得られるとの報告もある。例えば、有機ＥＬ素子を平面光源として利用することを考えると、数１０００ｃｄ／m^2の発光が必要であり、それに必要な電流は１００ｍＡ／ｃm^2以上になる。この場合には、素子温度は、１００°Ｃを超えることになり、輝度の低下や非発光点が発生し、素子の劣化が起こってしまう。従って、このような高輝度の有機ＥＬ素子では、発熱量が大きく、この対策が重要である。なお、熱による素子の劣化は、発光層などの有機層の構造変化や電極酸化の熱による加速が原因である。

【０００７】本発明は、上記課題を解決するためのなされたものであり、十分な封止が行えると共に、放熱特性のよい有機ＥＬ素子を提供することを目的とする。

【０００８】

【課題を解決するための手段】本発明は、一対の電極間に有機材料からなる発光層を狭持し、両電極からキャリアを発光層に注入することによって発光層を発光させる有機ＥＬ素子において、少なくとも一方の電極及び発光層の外側を覆う保護層であって、有機層と金属層の２層または無機層と金属層の２層を含む多層構造からなる保護層を有することを特徴とする。

【０００９】このように、本発明では、電極及び発光層を保護層で覆った。これによって、一方の電極（例えば金属陰極）及び発光層の周囲雰囲気への水分や酸素の拡散を防止することができ、素子の特性劣化を抑制して長寿命化を図ることができる。特に、保護層が金属層を含んでいる。金属層は、非常に緻密な構造を有しており、酸素や水分の拡散を効果的に防止する。さらに、金属層としてアルミなど不動態の酸化皮膜を形成するものを利用することで、酸素の拡散についても効果的に防止できる。

【００１０】また、金属層は、熱伝導性が良好であるため、素子において発生した熱を効果的に放散し、素子の加熱を防止することができる。特に、電流量を大きくして、発光量を大きくした場合には、素子の発熱量が大きく、その放熱性に優れていることが重要な要件になる。本発明によれば、このような大発光量の素子においても、特性の劣化を最小限にできる。

【００１１】また、電極上に絶縁層を配置すれば、金属層と陰極とを電気的に絶縁することができる。さらに、最外側に金属層を配置することにより、放熱効果を十分大きなものにすることができる。

【００１２】

【発明の実施の形態】以下、本発明の実施の形態（以下実施形態という）について、図面に基づいて説明する。

【００１３】図１は、本実施形態に係る有機ＥＬ素子の構成を示す図である。ガラス基板１０の上面には、透明

電極１２が形成されている。この透明電極１２は、ＩＴＯ（インジウム・チン・オキサイド）、SnO_2などが利用される。この透明電極１２の上に有機材料からなる正孔輸送層１４、発光層１６が積層形成される。正孔輸送層１４はＴＰＤ（トリフェニルジアミン）、発光層１６はＡｌｑ（キノリノールアルミ錯体）等により形成される。発光層１６の上には、金属陰極１８が形成される。この金属陰極１８には、ＭｇＡｇ（９：１）、ＡｌＬｉ（９．９：０．１）、Ｍａｌｎ（９：１）等が採用される。

【００１４】そして、この正孔輸送層１４、発光層１６、金属陰極１８の側面を含む全体を覆うように、保護層２０を形成する。この保護層２０は、絶縁層２０ａと金属層２０ｂの多層層であり、これらが２層ずつ交互に積層されている。ここで、絶縁層２０ａには正孔輸送層１４や発光層１６に用いたものと同じ有機物や、その他低分子、高分子の各種の有機物が利用できる。さらに、この絶縁層２０ａとして、有機層に代えて、無機層を採用することも好適である。例えば、MgF_2などの金属酸化物や半導体化合物の無機層を利用することができる。また、金属層２０ｂにはアルミ用いることができるが、Ｃｒ等各種の金属も利用可能である。

【００１５】このような有機ＥＬ素子において、透明電極１２と、金属陰極１８とに電圧を印加することで、両電極１２、１８より、正孔、電子が注入され、これが発光層１６において再結合し発光する。本実施形態では、保護層２０によって、正孔輸送層１４、発光層１６、金属陰極１８からなる素子部が覆われているため、大気からの酸素、水分の内部への拡散が有効に防止され、素子特性への悪影響を排除することができる。

【００１６】特に、本実施形態の素子においては、保護層２０が金属層２０ｂを含んでいる。金属層２０ｂは、非常に緻密な構造を有しており、酸素や水分の拡散を効果的に防止する。特に、金属層２０ｂとしてアルミなど不動態の酸化皮膜を形成するものを利用することで、酸素の拡散についても効果的に防止できる。

【００１７】また、金属層２０は、熱伝導性が良好であるため、素子部において発生した熱を効果的に放散し、素子部の加熱を防止することができる。特に、電流量を１００ｍＡ／cm^2～１Ａ／cm^2程度と大きくして、発光量を１０００～１００００ｃｄ／m^2と大きくした場合には、素子部の発熱量が大きく、その放熱が重要な課題になる。本実施形態の素子によれば、このような大発光量の素子においても、特性の劣化を最小限にできる。

【００１８】また、本実施形態では、金属陰極１８上に絶縁層２０ａを配置したため、これによって、金属層２０ｂと金属陰極１８とを電気的に絶縁することができる。さらに、最外側に金属層２０ｂを配置したため、放熱効果を十分大きなものにできる。

【００１９】なお、正孔輸送層１４、発光層１６は５０

ｎｍ程度、金属陰極１８は、２００ｎｍ程度、保護層２０の絶縁層２０ａ、金属層２０ｂは２００ｎｍ程度の厚さが好ましい。特に、金属陰極１８を２００ｎｍ以上という比較的厚いものにすることによって、放熱を非常に効果的なものにできる。

【００２０】また、上述の実施形態では、正孔輸送層１４と、発光層１６を積層形成したが、混合有機層の一層構成としてもよい。さらに、正孔輸送層１４ではなく、電子輸送層を金属陰極１８側に設ける構成としてもよい。さらに、透明電極１２を陰極とし、対向電極を陽極とすることも可能である。このように、素子部の構成には、現在知られている各種の構成を採用することができる。

【００２１】

【実施例】

「実施例１」ＩＴＯの透明電極１２が予め形成されているガラス基板１０上に、真空蒸着により、トリフェニルジアミンを５０ｎｍ堆積して正孔輸送層１４を形成し、その後キノリノールアルミ錯体を５０ｎｍ堆積して発光層１６を形成した。そして、この発光層１６上にＭｇＡｇを２００ｎｍ蒸着形成して金属陰極１８を形成し、素子を形成した。その後、この素子部の上に、MgF_2と、Ａｌを交互に積層し、絶縁層２０ａ、金属層２０ｂからなる保護層２０を形成した。この例では、絶縁層２０ａ、金属層２０ｂの厚み両方とも２００ｎｍとし、これらを３層ずつ形成した。

【００２２】この素子を駆動電流１０ｍＡ／cm^2で連続駆動して輝度の半減寿命を測定した。初期輝度２００ｃｄ／m^2で約３０００時間の寿命が達成できた（図２参照）。

【００２３】一方、金属陰極１８まで形成した素子（保護層２０なし）において、同様の駆動をしたところ、半減寿命は、約５００時間であった。この結果を図２に示す。また、駆動電流を５００ｍＡ／cm^2で連続駆動したところ、図３に示すように、３０分以上安定な発光が達成できた。一方、保護層２０がないものでは、素子温度が急激に上昇し、約１０分で輝度が０となってしまった。

【００２４】「実施例２」実施例１と同様の構成で、絶縁層２０ａとして正孔輸送層１４を構成する有機物であるトリフェニルジアミンを採用した。なお、金属層２０ｂとしては、上記と同様にＡｌを用いている。この素子を駆動電流１０ｍＡ／cm^2で連続駆動して輝度の半減寿命を測定した。初期輝度２００ｃｄ／m^2で約２５００時間の寿命が達成できた。

【図面の簡単な説明】

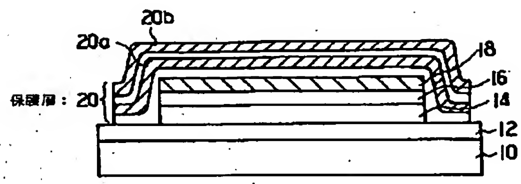
【図１】　有機ＥＬ素子の実施形態の構成を示す図である。

【図２】　同実施例の寿命を示す特性図である。

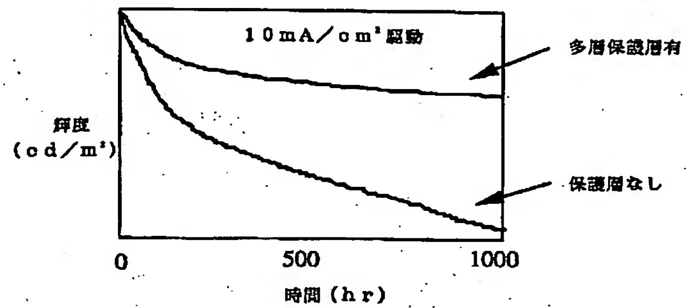
【図３】　同実施例の寿命を示す特性図である。

【符号の説明】
１０　ガラス基板、１２　透明電極、１４　正孔輸送層、１６　発光層、１８金属陰極、２０　保護層、２０ａ　絶縁層、２０ｂ　金属層。

【図１】



【図２】



【図３】